CHAPTER II

PROJECTED EXPERIENCE STRUCTURES, AND COSTS, FOR THE ENLISTED FORCES

The growth in the proportion of junior noncommissioned officers (NCOs) in the active services since the start of the All-Volunteer Force has set the stage for substantial growth in the senior career forces during the late 1980s and early 1990s. This chapter begins by showing projections of the extent of that growth under current policies. A number of assumptions that underlie the projections are detailed in the second section. Personnel costs will rise significantly over the period of the projections, as shown in the third section. The final section shows how much of the cost increases are attributable to seniority growth. It breaks the increases down into two components, one resulting from higher average pay grades and the other from longevity increases in basic pay.

## PROJECTED EXPERIENCE STRUCTURES

CBO's projections show sharply rising percentages of senior NCOs--enlistees with more than 10 years of service--through the mid-1990s (see Figure 2). 1/ This group should account for 33 percent of Air Force enlisted personnel in 1992, for example, compared with approximately 28 percent in 1985. The Navy and Army should show similar growth--smaller in terms of percentage points but larger relative to their starting positions of roughly 20 percent in 1985. The largest increase should occur in the Marine Corps: from 13.4 percent of the force to 19.6 percent. Given the modest growth in personnel strength planned for the Marine Corps, the rise implies a 50 percent increase in the number of senior NCOs.

For the most part, the projected growth in the senior NCO forces comes implicitly at the expense of the group in years-of-service five

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1. Figure 2 divides enlisted personnel into three groups: first-termers, approximated by those in years-of-service 1 through 4; junior NCOs (YOS 5-10); and senior NCOs (YOS 11 and above). The standard active duty service obligation for new recruits in the Navy, Air Force, and Marine Corps is four years. For consistency across the services, the figure treats four years as the first term. The majority of Army recruits, however, choose two- or three-year obligations. Some Marine Corps recruits also are eligible for three-year obligations, and Navy reservists going on extended active duty enter for two or three years.

Figure 2.
Projected Distribution of Active Enlisted Personnel,
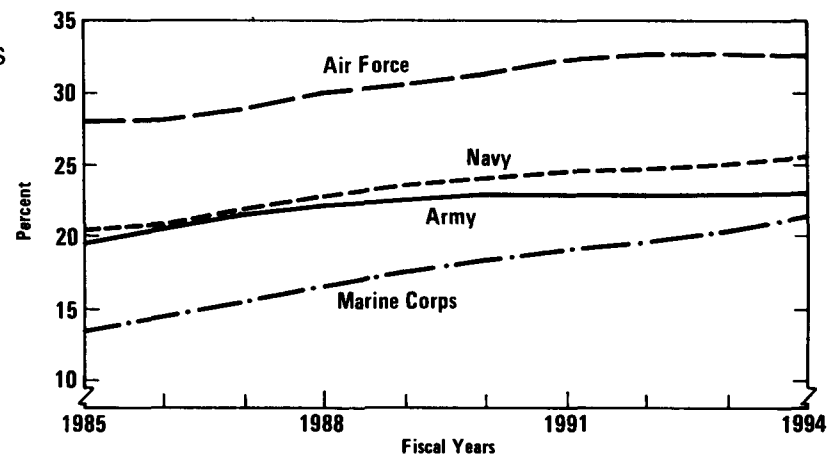by Years of Service, 1985-1994

One to Four Years
of Service
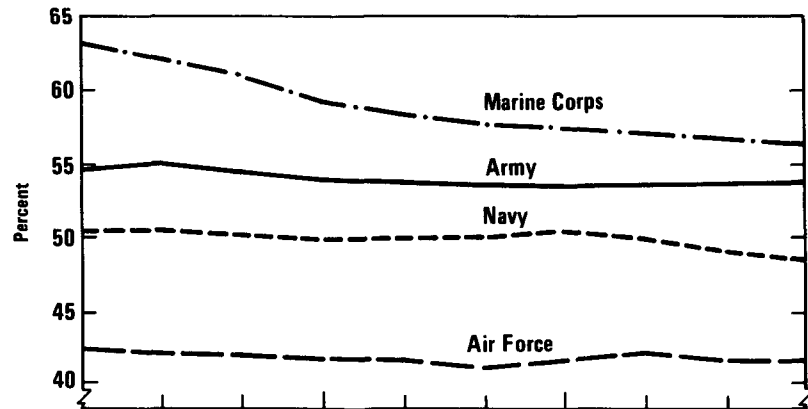
Five to Ten Years
of Service
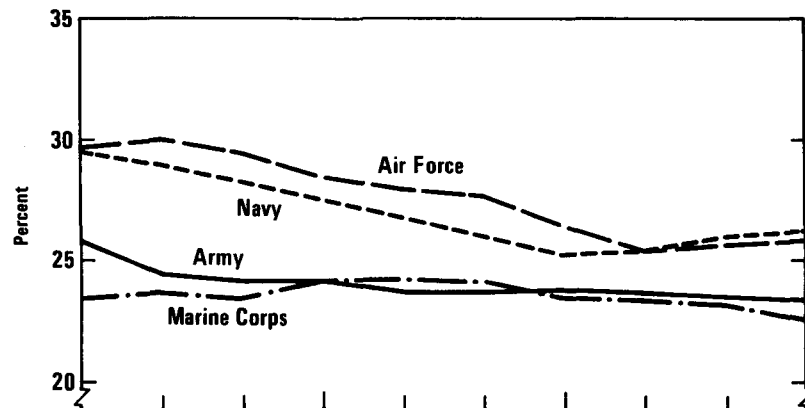
Eleven or More Years
of Service

SOURCE: Congressional
        Budget Office.

through ten. The Navy and Air Force, for example, show four percentage-point drops for this group, and less than one-half point drops for first-termers. In the Army the reduction is a little more evenly split between the two groups, but more than half comes from the junior NCO group. Only in the Marine Corps, the smallest service, is the shift predominantly from the first-term to the senior NCO force.

PROJECTION ASSUMPTIONS

This study derived its projections from the services' 1985 year-end experience profiles--the latest detailed data available. These were appropriately aged, and adjusted for a mixture of demand and supply effects. The key demand-side factors are the services' reenlistment policies. Year-to-year changes in force sizes also play a role, although more in determining costs (below) than in affecting experience profiles. On the supply side, service members' propensities to remain in the military have been shown to be influenced by military pay levels and the availability of private-sector jobs. This section discusses the demand and supply factors in turn, and then identifies the study's major economic assumptions.

Demand-side Factors

The projections of experience profiles shown above, as well as those discussed in Chapter 4, assume that, in the absence of any change in members' propensity to remain in the military, retention rates would remain constant at their 1985 levels. This is roughly equivalent to assuming that the services will not change their policies for determining who is eligible to reenlist, and that reenlistment bonus funding will keep pace with the numbers of personnel reaching key reenlistment points. 2/

The magnitude of the changes in experience profiles projected here raises some questions about the services' willingness to accede to them, and thus about the validity of the above assumption. 3/ Restricting reenlist-

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2. The assumption also implies that new recruits will distribute themselves among initial tour lengths as they did in 1985, and that the tour lengths required of reenlistees will not change.

3. This is most true for the Marine Corps, but because it is the smallest service this study did not explore the sorts of policies that could be implemented to restrict seniority growth. The Army tightened reenlistment standards in 1983 and 1984, but this apparently was done to weed out marginal performers rather than to reduce seniority growth.

ments, however, would put greater pressure on recruiting. This would not be desirable in the 1990s, when enlistment-age cohorts will be smaller than they have been in the 1980s.

Accession Levels. If reenlistment policies do not change, then accession levels--the numbers of new recruits brought in--will have to be adjusted to accommodate desired strength levels. 4/ Strength increases, for example, would be achieved by increasing accessions rather than by easing reenlistment standards or offering additional inducements for reenlistment. Accession adjustments would be feasible, as the requirements generated under all of the options considered here are modest by historical standards.

Enlisted Strength Plans. The projections shown in Figure 2 assume that the Congress will authorize the enlisted force sizes envisioned in the services' budget submissions for fiscal year 1988. These submissions call for modest growth in Marine Corps personnel strength, more substantial growth for the Navy, a small drop in Air Force strength in 1988, and an essentially constant size for the Army. Figure 3 shows the plans in terms of percentage changes from 1987 strength levels. Small deviations from these plans--1 percent or 2 percent, for example--would not markedly affect the experience distributions of the forces.

Supply-Side Factors

When employment conditions in the civilian economy change, military retention rates are affected. Private-sector pay increases that are not matched by raises in the military cause more service members to leave, as does falling civilian unemployment. The projections of the services' experience structures through this report reflect adjustments for the effects of projected changes (described below) in these two factors. 5/

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4.   This study assumed that neither these adjustments, nor outside factors such as the declining size of enlistment-age cohorts, would alter the demographic mix of entering recruits (including education and test scores). This implies that there will be a modest increase in recruiting resources. Even without this increase, however, the demographic mix probably would not change enough to affect significantly the projections of experience structures.

5.   The projections assume that the stay/leave decisions only of those members completing their current enlistment tours in a given year would be affected by outside factors. Most changes in status--extensions, reenlistments, losses--occur among this group.

Figure 3.
Planned Changes in Enlisted Strengths from 1987 Levels
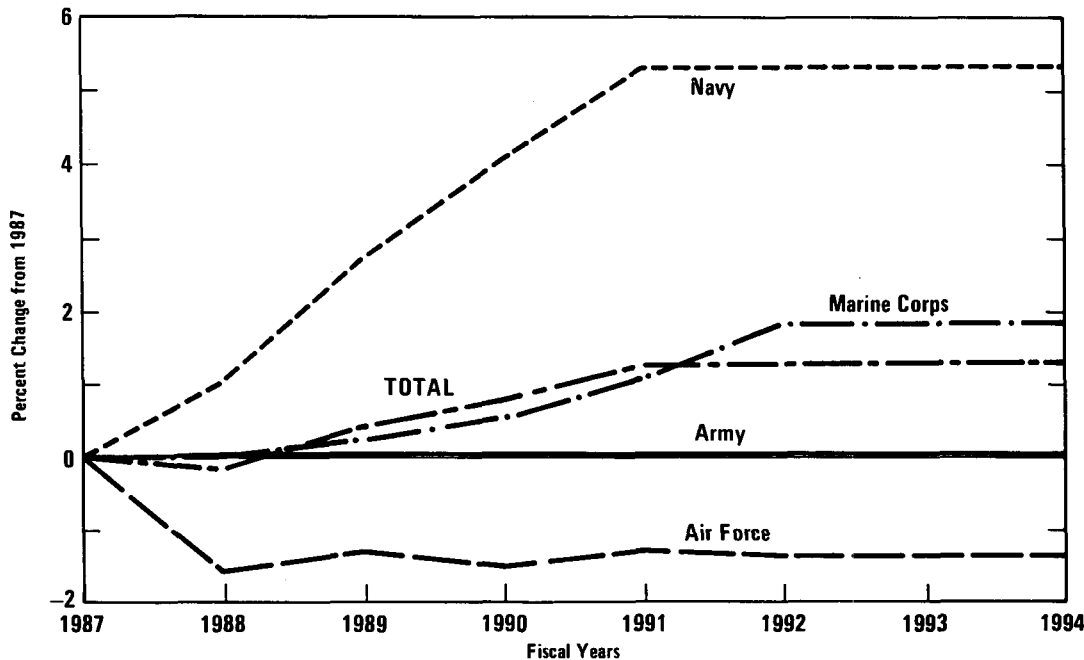
SOURCE: Department of Defense (through 1992).

The effects of changes in pay and civilian unemployment were derived from statistical estimates for the parameters of a model of retention decisions called the Annualized Cost-of-Leaving (ACOL) model. This model assumes that the underlying preferences of individual service members for military as against civilian employment are constant over time. 6/ Appendix A gives the full set of pay and unemployment effects that were used.

Military Pay Levels. For this study, it was assumed that military pay raises would be given on October 1 of each year and would match private-sector

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6.   For a description of the model, see Department of Defense, Office of the Secretary of Defense, *Fifth Quadrennial Review of Military Compensation,* Volume 1B, "Supporting Appendixes to Uniformed Services Retirement System," Appendix I (January 1984). The present study used computer software and data developed for this Review. A brief description of the ACOL model appears in Congressional Budget Office, *Elimination of Double Tax Benefits for Military Homeowners* (March 1986). For a theoretical development and comparison of alternative models, including the ACOL, see John T. Warner, *Military Compensation and Retention: An Analysis of Alternative Models and a Simulation of a New Retention Model* (Arlington, Va: Center for Naval Analyses, CRC-426, August 1981).

pay increases during the preceding years. One exception to this rule is 1988; as this report was prepared, it seemed likely that the 1988 raise would be 3 percent on January 1, 1988, slightly smaller than the projected private-sector increase in 1987. After 1988, the assumed matching requires real growth in military pay of about 1.5 percent per year. 7/

Civilian Unemployment. CBO's projections show a gradual drop in civilian unemployment to 5.8 percent in 1991.

COST PROJECTIONS

This study projects a rise of roughly 5.3 percent in real personnel costs between 1987 and 1992--about $2.6 billion in 1987 dollars--with continued increases thereafter. Table 1 shows the cost estimates for the enlisted force projections presented in the first section of this chapter, aggregated into 12 broad categories. 8/ The cost totals should not be confused with the military personnel costs in CBO's baseline projections of the federal budget, which implicitly assume no seniority growth and no personnel strength changes. These factors are accounted for in the Administration's budget request, but the projections here differ from the Administration's because of differences in assumptions and in the treatment of inflation.

Basic pay and its associated allowances for quarters (BAQ) and subsistence (BAS) account for more than half of the total personnel costs identified in the table. They account for an even larger share of cost growth, in part because the economic assumptions stated above imply modest real growth in military pay. Virtually all of the cost growth appears in the direct

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7. Congressional Budget Office, *The Economic and Budget Outlook: Fiscal Years 1988-1992* (February 1987).

8. Although enlistment and reenlistment bonuses are normally included in personnel costs, this study did not attempt to project costs for these programs. Bonuses are designed to correct shortages in specific military occupations, a level of detail that was beyond the scope of this study. As noted in the previous section, an implicit assumption about aggregate levels of reenlistment bonuses underlies the projections of retention rates, but that assumption could not readily be translated into cost projections.

TABLE 1.   ENLISTED PERSONNEL COST PROJECTIONS BY
            CATEGORY, FOUR-SERVICE TOTAL, 1987-1994
            (In billions of 1987 dollars)

Category	1987	1988	1989	1990	1991	1992	1993	1994
Basic Pay	22.0	21.9	22.3	22.7	23.2	23.7	24.1	24.6
Basic Allowance for Quarters	2.7	2.7	2.8	2.8	2.9	3.0	3.0	3.1
Basic Allowance for Subsistence	3.0	2.9	3.0	3.0	3.1	3.1	3.2	3.2
Other Pays	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Other Allowances	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
Social Security Payroll Tax (FICA)	1.6	1.6	1.7	1.7	1.8	1.8	1.8	1.9
Permanent-Change-of-Station Travel	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Other Costs	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2
Retired Pay Accrual	11.5	11.2	11.2	11.2	11.3	11.4	11.6	11.8
Individual Training	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Recruiting and Examining	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Medical Costs	3.4	3.4	3.4	3.5	3.6	3.7	3.7	3.8
Total Cost	49.5	49.1	49.8	50.5	51.4	52.2	53.0	53.9

SOURCE: Congressional Budget Office.

pay categories and in others that are tied, formally or informally, to basic pay. 9/ This study assumed that cost elements not tied to basic pay, such as the cost per PCS move, would not change in real terms, although total costs in these categories could vary with changes in strength levels. Minor variations would be evident in some of these nonpay categories if the figures were not rounded to the nearest $100 million.

Sources of Cost Growth

Table 2 breaks down the cost increases over 1987 levels into components associated with five factors: the richer mix of pay grades that may come with seniority growth; higher average pay levels because of longevity in-creases in basic pay; changes in personnel strengths; changes in real pay levels; and changes in retirement accrual rates. The first two, which to-gether make up the cost of seniority growth, are discussed in detail in the next section.

Increases in real (inflation-adjusted) pay rates are the biggest single factor in raising enlisted personnel costs, accounting for more than 60 per-cent of projected cost growth. In the 1990s, annual increases of roughly $700 million (1987 dollars) will be required if military pay is to keep pace with private-sector pay. Pay raises also affect the cost growth attributable to other sources: personnel strength increases, for example, become more costly.

Major cost savings should result from the enactment, in 1986, of a less costly retirement system. Although the system applies only to those who entered after August 1, 1986, they will make up an increasing share of all personnel. The growing coverage of the new system contributes to a steady reduction in the percentage of basic pay--the normal cost percentage--that the Defense Department projects must be set aside to fund military retire-ment.

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9.   Categories tied to basic pay include BAQ, BAS, Social Security tax payments (FICA), separation pay, unemployment benefits, the accrual charge for military retirement, and (under the assumptions of this study) medical costs. The accrual charge is computed as a percentage of total basic pay--the so-called "normal cost percentage"--and thus will rise or fall in real terms with basic pay. In addition, however, the percentage figure that DoD uses can vary from year to year as the structure and retention rates of the personnel force vary, and will fall as a less costly retirement system, enacted in 1986, covers a growing percentage of personnel. This study used DoD's projections of the normal cost percentage, which show a drop from 52.2 percent in 1987 to 47.8 percent in 1992 (the latter figure was assumed to apply in 1993 and 1994 as well). The falling percentage explains why costs for retired pay accrual do not rise proportionately with basic pay.

TABLE 2.   SOURCES OF GROWTH IN PERSONNEL COSTS OVER
           1987 LEVELS (In millions of 1987 dollars)

Source of Growth	1988	1989	1990	1991	1992	1993	1994
Richer Grade Mix	90	100	180	220	300	360	430
Longevity Pay Increases	220	220	250	300	420	520	570
Personnel Strength Changes	-70	220	390	630	660	670	680
Real Pay Changes	-430	210	760	1,520	2,240	2,920	3,620
Changes in Retired Pay Accrual Rates a/	-220	-440	-640	-840	-970	-970	-970
Total	-410	310	930	1,830	2,640	3,500	4,330

SOURCE: Congressional Budget Office.

NOTE: The figures in each line were calculated under the assumption that the sources of growth in the lines above had been eliminated. Altering the order of computation would cause minor changes in the figures.

a.   Effects of changes in the normal cost percentage used in calculating the accrual charge for retired pay.

Personnel strength changes account for about one-quarter of the cost increases through 1991, when the Navy's planned growth will end. The small cost reduction in 1988 reflects a planned cut in Air Force enlisted strength in that year.

THE COSTS OF SENIORITY GROWTH

Seniority growth could add $720 million to personnel costs in 1992, and $2.3 billion over the five years 1988 to 1992. 10/ The two components of these increases--changes in the mix of pay grades and higher average pay levels within grades--are not equally likely, however, as the discussion below makes clear.

10.   The CBO baseline projections of the federal budget, used by the Congress in the budget process, implicitly assume that there will be no seniority growth. Thus, the cost increases may be interpreted as additions to the CBO baseline projections.

TABLE 3.   PERCENT DISTRIBUTION OF ENLISTED FORCES BY
             PAY GRADE, 1985 ACTUAL AND 1992 PROJECTED

Pay Grade	Army 1985	Army 1992	Navy 1985	Navy 1992	Marine Corps 1985	Marine Corps 1992	Air Force 1985	Air Force 1992
E-1 to E-3	29.8	29.4	32.9	32.2	51.2	48.9	31.4	30.9
E-4	29.0	28.5	20.9	20.4	18.1	16.5	23.7	21.1
E-5	17.5	17.1	20.8	19.0	13.9	13.8	22.7	22.7
E-6	13.0	12.5	15.9	16.9	8.7	9.8	11.7	13.7
E-7	7.8	9.1	6.6	8.2	5.2	7.3	7.6	8.5
E-8 and E-9	2.9	3.5	2.9	3.3	2.8	3.8	2.9	3.0

SOURCE: Congressional Budget Office based on data from Defense Manpower Data Center.

Changes in the Mix of Pay Grades

A more senior force will naturally mean a larger percentage of personnel in the senior pay grades unless either smaller percentages of personnel are promoted to the senior grades or promotion to those grades is delayed. In estimating costs, this study assumed that the 1987 mixes of grades within years of service would be maintained (although the grade mix for all personnel would change as seniority grows). This is roughly equivalent to assuming that promotion rates and timings remain as they were in the early 1980s.

Under the promotion assumption, this study projects substantial increases in the percentages of senior NCOs--those in grades E-7 and above-- between 1985 and 1992 (see Table 3). 11/ The Navy, for example, shows a rise from 9.5 percent to 11.5 percent, and the Army from 10.7 percent to

11.   This study did not formally model the enlisted promotion process. It derived the percentages for 1992 by applying estimated 1987 distributions of grades within each year of service to the projections of 1992 year-of-service distributions. This procedure should approximate the effects of maintaining the promotion practices that led to the 1987 grade distributions. The 1987 estimates were formed by combining detailed information on 1985 distributions with less detailed information for 1987 published by the services.

12.6 percent. 12/ The percentage of mid-level NCOs--those in grade E-6-- is also projected to rise in every service but the Army.

Personnel Costs. The projected shift in the grade distributions adds $300 million to personnel costs in 1992 (see Table 4), relative to what costs would be if the aggregate mix of pay grades in each service stayed as it was in 1987. 13/ This amounts to roughly 0.6 percent of total personnel costs. Over the five-year period 1988 to 1992, the grade shift adds a total of nearly $900 million to costs. It continues to raise costs well beyond the period of the projections, driven primarily by continued seniority growth in the Navy and Marine Corps.

Promotion Cuts. Experience suggests that some growth in the numbers of senior NCOs will take place, but it may not be as great as the projections indicate. The number of enlisted members in the two highest grades cannot legally exceed 3 percent in any of the services, a constraint that is violated by three of the services in the projections. Limits on the percentages in the top six grades (E-4 and above), which are not legally binding, might also be violated, although for the most part the shifts occur within the top six grades. The Marine Corps is the obvious exception to this generalization, as shown by the substantial drop for its lowest three grades.

Slowing promotions to maintain the 1987 grade distributions, and thus eliminate the costs projected in Table 4, would require delays for several grades. In the Marine Corps, for example, personnel in grade E-5 would have to serve about 21 months longer in the 1990s than in the past before being promoted to E-6. They would then spend a few months less in that grade than in the past, but their total time in service before promotion to E-7 would still be well over one year greater. 14/ Delays would be shorter in the Army and Navy (roughly six months to one year more time in service

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12. If legal limits on the percentage of enlisted personnel in grades E-8 and E-9 were not relaxed, all of the projected growth would have to appear in grade E-7. Adjusting for this would not have a major effect on the cost projections (below) because of the small numbers of personnel involved.

13. This assumes no change in retention rates in response to promotion delays or reduced promotion rates. Reduced retention would tend to cut costs further, for given enlisted strength levels.

14. The delays given are the differences, between 1987 and 1992, in the year and month of service at which half of the personnel remaining have been advanced to the next higher grade. Because they were not derived from a formal model of promotion, the numbers are approximate and would not correspond exactly to changes in promotion timing as calculated by the services.

before promotion to E-6 and E-7) and shortest in the Air Force. Alternatively, reduced promotion rates could achieve similar savings.

The cost figures in Table 4 can be viewed as potential savings, savings that could be realized without forcing mid-level NCOs to leave and thus losing the advantages of their experience. 15/ The second component of seniority-growth cost is more inevitable, arising primarily from the structure of the military basic pay table.

Longevity Increases in Basic Pay

The military basic pay table incorporates longevity increases--that is, pay raises that automatically occur as a member's years of service rise, even if the member is not promoted to a higher grade. As a result, increased seniority means increased basic pay costs even when the aggregate distribution of grades within each service is held constant. Other cost elements also grow--medical care costs, for example (in part because older personnel tend to have more dependents). 16/

Longevity increases in pay, and increases in other cost categories affected by the year-to-service distributions of enlisted personnel, will contribute $420 million to personnel costs in 1992, and more than $1.4 billion over the five years 1988 through 1992 (see Table 5). 17/ In 1992, the last year of the Five Year Defense Plan, personnel costs will be almost 1 percent higher than they would be if the 1987 experience structures were maintained. Cost growth would continue in 1993 and 1994, and probably well beyond the end of the projection period.

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15.   Some would choose to leave, of course, because slowed promotion would reduce their future military pay. Reduced retention would tend to increase the savings, at the cost of lost experience. As noted above, this study ignored the retention effect in projecting the cost savings under slowed promotion. Available studies of retention tend to derive their predictions of the effects of changing promotion policies--if they do so at all--from assumptions about members' rates of time preference.

16.   Some costs fall--training costs, for example--because more senior personnel have lower loss rates, but these reductions are small compared with the increases in pay costs.

17.   These estimates result from projecting the costs of the 1987 forces in each future year, adjusting the factors determining costs--accessions, losses, personnel by year of service --in proportion with planned strength changes. These costs were compared with the costs of the projected forces (Figure 2), under the assumption that the aggregate mix of grades within each service would be the same as in 1987 (that is, the service-specific costs underlying Table 1 less the grade-mix costs in Table 4).

TABLE 4.   PROJECTED COSTS OF SENIORITY
                GROWTH ARISING FROM MAINTAINING
                PROMOTION RATES AND TIMINGS

Service	1988	1989	1990	1991	1992	1993	1994
In Millions of 1987 Dollars							
Army	20	40	60	80	90	100	100
Navy	20	10	30	40	80	110	140
Marine Corps	10	30	50	60	70	90	110
Air Force	40	20	40	40	60	70	80
Total	90	100	180	220	300	360	430
As a Percent of Personnel Costs							
Army	0.1	0.2	0.4	0.4	0.5	0.5	0.5
Navy	0.1	0.1	0.2	0.3	0.5	0.7	0.9
Marine Corps	0.3	0.6	1.0	1.3	1.5	1.9	2.2
Air Force	0.3	0.2	0.3	0.3	0.5	0.5	0.6
Total	0.2	0.2	0.3	0.4	0.6	0.7	0.8

SOURCE: Congressional Budget Office.
NOTE: Numbers may not add to totals because of rounding.

TABLE 5.   PROJECTED COSTS OF SENIORITY GROWTH ARISING
                FROM LONGEVITY INCREASES IN PAY

	1988	1989	1990	1991	1992	1993	1994
In Millions of 1987 Dollars							
Army	20	50	70	100	120	130	140
Navy	50	40	50	70	150	200	230
Marine Corps	50	40	50	60	80	90	110
Air Force	110	90	80	70	80	110	100
Total	220	220	250	300	420	520	570
As a Percent of Personnel Costs							
Army	0.1	0.3	0.4	0.5	0.6	0.7	0.7
Navy	0.4	0.3	0.3	0.4	1.0	1.3	1.5
Marine Corps	1.1	1.0	1.2	1.4	1.7	1.9	2.2
Air Force	0.8	0.7	0.6	0.5	0.5	0.7	0.7
Total	0.4	0.5	0.5	0.6	0.8	1.0	1.1

SOURCE: Congressional Budget Office.
NOTE: Numbers may not add to totals because of rounding. Figures include changes in all cost
            categories that are affected by the year-of-service mixes of the enlisted forces.

The service breakdowns show patterns consistent with the year-of-service projections displayed in Figure 2. The Air Force dominates the total cost growth in the early years because its planned strength cut in 1988 will immediately reduce the percentage of lower-paid junior personnel in its enlisted force. The Navy accounts for the largest share beginning in 1992 as it completes its enlisted strength buildup and reduces its annual accession requirements. Throughout the projection period, Marine Corps costs for seniority growth are largest as a percent of the service's total personnel costs. As Figure 2 showed, the Marine Corps is projected to have the greatest growth in senior NCO strength. Moreover, most of that growth comes implicitly at the expense of the lowest-paid group, those in their first enlistment terms.

Unlike the costs in Table 4, the estimates in Table 5 do not indicate the savings that would result from any specific set of policies. Growth in experience could be slowed, of course, but maintaining 1987's year-of-service structures even roughly would prove very difficult. Nonetheless, the costs in Table 5 provide a useful benchmark against which to assess the productivity gains that are the subject of Chapter III.

CHAPTER III

EXPERIENCE AND PRODUCTIVITY

Chapter II showed that growing seniority will be an important trend in the enlisted forces in the late 1980s and early 1990s. It also showed that this growth will add an average of between $450 million and $800 million dollars per year to personnel costs in 1991 through 1994, depending on promotion and other policies. This chapter raises the question: Are the returns to greater seniority sufficient to justify the added costs?

The data available to address the question are very limited. This may seem surprising, given that the shift toward a more senior force has been under way since the start of the All-Volunteer Force. The lack of data reflects the ways in which the services determine how many personnel they require and at what experience levels. The key term is "require": the notion of requirements assumes that there is one best way to staff any function. Any shortfalls, such as giving a unit fewer personnel even though they have a richer experience mix than the stated requirement, are assumed to degrade performance. Although in a steady state this approach is probably appropriate for the services' personnel programming functions, it does not lend itself to deriving trade-offs among personnel of different experience levels. 1/

Fortunately for the purposes of this study, two attempts to measure productivity at various levels of experience have yielded useful information. The Enlisted Utilization Survey (EUS), conducted by the RAND Corporation for the Defense Advanced Research Projects Agency in the mid-1970s, examined productivity growth during the first enlistment term for a variety of enlisted specialties in the Army, Navy, and Air Force. Subsequent analyses of the data at RAND and at the Center for Naval Analyses (CNA) revealed strong relationships between experience and productivity. 2/ The second

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1. It also limits the manpower system's flexibility, a point that is raised in the final section of this chapter.

2. Gus W. Haggstrom, Winston K. Chow, and Robert M. Gay, *Productivity Profiles of First-Term Enlisted Personnel* (Santa Monica, Calif.: The RAND Corporation, N-2059-RC, February 1984). Alan J. Marcus and Aline O. Quester, "Determinants of Labor Productivity in the Military" (Alexandria, Va.: Center for Naval Analyses, November 1984).

attempt, also a RAND study but in this case performed for the U.S. Air Force, found substantial productivity growth over a full range of experience levels. 3/ These two studies are described in greater detail below.

A third study, which followed a very different approach from the first two, confirms that the experience/productivity relationships found in the above studies are not simply a result of their survey-based approaches. In those two studies, supervisors were asked to rate the performances of the personnel working under them. The third study, an examination of various occupational specialties aboard Navy ships, relied on a more objective output measure: the amount of time that major systems served by personnel in the selected specialties were not fully operational. 4/ These downtimes were related to the characteristics of the personnel servicing the systems, including in each case some measure of average experience. The results are not directly usable in the present analysis because of the forms of the experience measures, but some statistically significant relationship between experience and output was found for all but one of the enlisted specialties examined. 5/

The next two sections describe the two studies that provide the productivity data for this examination, showing how they were used to derive service-specific indexes of productivity by year of service. Most of the details are relegated to Appendix B; what appears below is required for an understanding of the limitations that the available data impose on the conclusions drawn in the next chapter. The third section presents the major results of this chapter: projections of aggregate productivity levels for each of the services. The final section discusses the major limitations of the data and, by extension, of the productivity projections.

THE ENLISTED UTILIZATION SURVEY

In the EUS, 27,000 first-term enlisted personnel were first asked to identify their immediate supervisors. In a written survey, those supervisors were

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3. S. Craig Moore, *Demand and Supply Integration for Air Force Enlisted Work Force Planning: A Briefing* (Santa Monica, Calif.: The RAND Corporation, N-1724-AF, August 1981).

4. Stanley A. Horowitz and Allan Sherman, *Crew Characteristics and Ship Condition* (Alexandria, Va.: Center for Naval Analyses, CNS 1090, March 1977).

5. Another study employing an objective performance measure is: A. J. Marcus, *Personnel Substitution and Navy Aviation Readiness* (Alexandria, Va.: Center for Naval Analyses, Professional Paper 363, October 1982). The results indicated that, at the margin, personnel in grade E-7 and above are several times more productive than personnel in the junior NCO grades. This is too large a difference to be accepted without confirming studies.

then asked to estimate the net productivity of the first-termers identified in the first round at four points during their initial tours. 6/ The survey explained that net productivity means the contribution of the individual to the unit's output after accounting for the supervision time that the individual requires. Productivity was measured relative to that of a fully trained "journeyman," someone with exactly four years of service completed.

The RAND analysis of the EUS data derived usable results for occupational specialties in all three of the services surveyed, including 16 in the Army, 10 in the Navy, and 22 in the Air Force. Each specialty had been designated in the original survey effort as either high-, medium-, or low-skill, to assure a broad sample of skills in each service. For various reasons, the responses of many supervisors were excluded, leaving usable data for 9,272 individuals. 7/ For each specialty, RAND averaged the productivity estimates among respondents at each of the four time-in-service points, and then fitted standard learning curves to the four values.

The CNA analysis of the same EUS data used different methods but yielded results on the relationship between experience and productivity that were remarkably similar to those of the RAND study. Averaging among Navy specialties yields a total productivity over the four years of a first term, expressed in journeyman-equivalent man-years, of 2.28 years for the RAND analysis and 2.34 years for the CNA analysis. 8/ Given the range among specialties--from roughly 1.8 to 2.8--this difference in the averages is very small. Because of the small differences, and for consistency among the services, this study relied exclusively on the RAND results.

The aggregate learning curves derived from the RAND analysis, shown in Figure 4, appear plausible. The curves indicate the average productivity during each year of service, expressed--as it was by the rating supervisors--

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6.   The four points were: during the individual's first month at his initial duty station; at the time of the rating; one year after the rating; and after four years of service. Ratings of "typical" first-termers were also solicited, although these were not used in the current study. The typical enlistees were generally rated as less productive, on average, than the specific individuals.

7.   The exclusions were made to ensure that: the supervisor had a reasonable basis for providing estimates for the individual's entire first term; technical school graduates were being evaluated in the specialty for which they were trained; necessary data for the analysis were available; and the supervisors correctly understood the concept of relative net productivity.

8.   The largest difference for any individual specialty was 0.23 man-years; in most cases the differences were much smaller.

Figure 4.
Productivity Indexes by Service and Year of Service
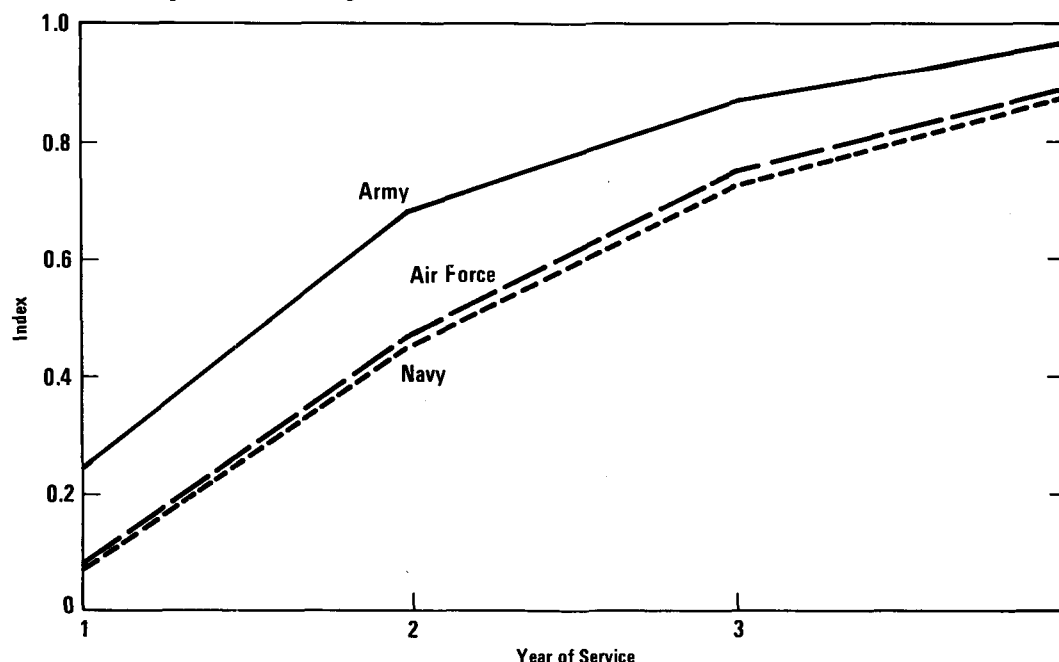
SOURCE: Congressional Budget Office, from the RAND Corporation.

NOTE: Productivity is measured relative to that of a typical enlistee who has completed four years of
service.

as a fraction of the productivity of a fully trained journeyman (that is, a typical individual who has just completed four years of service). 9/

As should be expected, average productivity is very low during the first year of service. This results from the combination of low productivity once the recruit reaches his first duty station, and the several months of training time that precede the first assignment. Productivity during training is assumed to be zero. 10/ The higher values for the Army than for the

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9.   Because the indexes measure average productivity over the course of the given years of service, the values in the fourth year are less than one. In addition, estimated productivity at the end of four years could differ from one because this study used the results for actual recruits, rather than for "typical" recruits. The reference person in both cases (the fully trained journeyman) was a typical enlistee with four years of service completed.

10. Net productivity during formal training, basic and advanced, would actually be negative because of instructors' time inputs. This study did not attempt to take account of changes in aggregate productivity arising from changes in the total number of instructors required as accession levels vary.

other two services are consistent with the view that Army jobs are more easily learned. It should be noted, however, that the EUS data do not provide a clear indication that the skill level of a specialty (as determined in the original survey project) affects productivity.

Lacking any direct information on productivity in the Marine Corps, this study used the Army index for that service.

The age of the EUS data (the survey was conducted in 1975) is a cause for concern about their applicability to today's forces. Inevitably, it limits the conclusions that can be drawn about the future productivities of the enlisted forces. The final section of this chapter discusses these limitations.


THE RAND AIR FORCE STUDY

Like the EUS, the study performed for the Air Force was survey-based, but there the similarity ends. A demonstration effort, it examined only one specialty. It collected data on completion times for 26 separate groups of tasks typically performed by personnel in that specialty. Most important, the data covered personnel classified into six "labor types," covering a full range of experience, rather than just personnel in their first terms. 11/

The study was intended to demonstrate how requirements for personnel of different skill levels and grades could be changed to improve the match between requirements and available supplies. The data collected were similar, but not identical, to data routinely collected within the Air Force's Management Engineering Program. The single specialty, Aerospace Ground Equipment (AGE) Maintenance, was one of two areas selected as broadly representative prototypes. 12/ In the EUS, this specialty was identified as "medium-skill."

The nature of the data collected is illustrated in Figure 5, which gives relative completion times by year of service for three representative task groups: periodic inspection, unscheduled maintenance (simple equipment/subsystems), and corrosion control. All times are measured relative to the time required by a person in the highest labor type (the plotted points

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11. Labor types were defined by a combination of pay grade and skill level, an Air Force measure of proficiency.

12. The project was halted before data were collected for the second area, General Accounting.

Figure 5.
Relative Task Completion Times
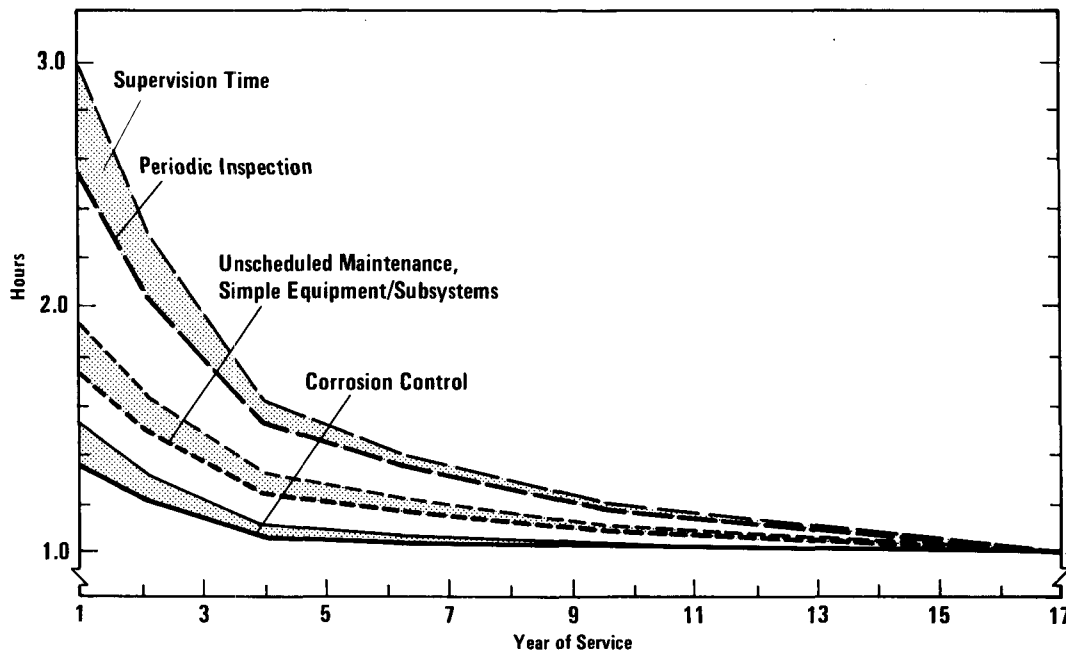
SOURCE: Congressional Budget Office, from RAND Corporation data.
NOTE: Thin lines include supervision time.

are at the average year of service for each labor type). Two lines appear for each task group; the upper line includes the supervision time required. For example, the top pair of lines shows that a person in the lowest labor type, who on average would have completed one year of service, requires 2.5 hours to perform a periodic inspection job that the most experienced person could complete in one hour. In addition, the equivalent of 0.5 hours of the junior person's time would be required for supervision of the work. 13/ For corrosion control, the advantage of experience is much less, particularly beyond the fourth year of service.

The detail of the data presents problems for the derivation of a single aggregate index of productivity by year of service. It is not sufficient simply to calculate such an index separately for each group of tasks and then to average the indexes at each year of service; to do so would be to assume, implicitly, that the time of every member is spread across tasks in the same proportions. In an actual work center, task assignments would be made more rationally, with experienced personnel assigned primarily to tasks in which their performance advantages over junior personnel are

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13.   The supervision would be performed, of course, by a more senior person.